WHAT IS CLAIMED IS:

1. A method for recognizing the type of modulation of a complex baseband signal extracted from a modulated signal having a carrier frequency, said method comprising the steps of:

(a) generating a pre-processed signal from the baseband signal;

(b) examining amplitude variations in the pre-processed signal to identify the type of envelope thereof as being one of a constant envelope and an irregular envelope;

(c) estimating the carrier frequency error in the pre-processed signal;

(d) correcting the pre-processed signal for the carrier frequency errors to generate a carrier-corrected signal; and

(e) classifying the type of modulation in the carrier-corrected signal, based on the type of envelope identified in the examining step.

2. The method of claim 1, wherein the generating step includes a step of detecting presence of the baseband signal by estimating the power spectral density thereof with the aid of externally measured background noise power, and comparing said power spectral density against a power threshold derived from the background noise and a predefined probability of detection.

3. The method of claim 2, wherein the generating step further includes, after the detecting step, a process of gross error correction of the carrier frequency.

4. The method of claim 3, wherein the gross error correction process includes the steps of:

(a) estimating baseband frequency bandwidth by comparing the power spectral density against a bandwidth threshold derived from the background noise and a predefined bandwidth estimation error and a predefined probability of detection;

(b) estimating main centroid frequency of the baseband signal, by determining a component centroid frequency of at least one frequency component in the power spectral density bearing a power above the bandwidth threshold; and

(c) frequency translating the baseband signal by the main centroid frequency, followed by low-pass filtering with a filter bandwidth derived from the baseband frequency bandwidth.

5. The method of claim 1, wherein when the type of envelope is identified as a constant envelope, the classifying step classifies the type of modulation according to the phase and frequency contents of the pre-processed and carrier-corrected signals.

6. The method of claim 1, wherein when the type of envelope is identified as an irregular envelope, the classifying step classifies the type of modulation according to the phase and amplitude contents of the carrier-corrected signal.

7. The method of claim 1, wherein when the type of envelope is identified as a constant envelope, the step of estimating the carrier frequency error includes the steps of:

(a) obtaining the normalized squared amplitude of the carrier-corrected signal and applying thereto a Fast Fourier Transform (FFT) with zero-padding to generate an FFT output;

(b) squaring the absolute values of the FFT output to generate a frequency spectrum;

(c) searching the frequency spectrum to find a maximum-power frequency sample; and

(d) performing a fine search for the carrier frequency error, by applying one step of a secant optimization process to the maximum-power frequency sample and the pre-processed signal.

8. The method of claim 1, wherein when the type of envelope is identified as an irregular envelope, the step of estimating the carrier frequency error includes the steps of:

(a) obtaining the normalized squared amplitude of the carrier-corrected signal and applying thereto a Fast Fourier Transform with zero-padding to generate an FFT output;

(b) obtaining the square of the absolute values of the FFT output to generate a frequency spectrum;

(c) searching the frequency spectrum to find a maximum-power frequency sample; and

(d) performing a fine search for the carrier frequency error, by applying one step of a secant optimization process to the maximum-power frequency sample and the output of the normalized squared amplitude signal.

9. The method of claim 1, wherein when the type of envelope is identified as a constant envelope, the step of classifying the type of modulation includes the steps of:

(a) obtaining the direct phase variance for samples of the carrier-corrected signal above the mean amplitude of the carrier-corrected signal;

(b) comparing the direct phase variance to a predefined phase threshold; and

(c) classifying the type of modulation as Continuous Wave when the direct phase variance is below the phase threshold, and as Frequency Modulation when the direct phase variance is above the phase threshold.

10. The method of claim 9, wherein when the type of modulation is classified as Frequency Modulation, the classifying step further includes the steps of obtaining the instantaneous frequency distribution of the pre-processed signal and obtaining the FFT of the said instantaneous frequency distribution, such that the type of modulation is classified as analog FM when the presence of a tone is detected in the FFT of the instantaneous frequency distribution.

11. The method of claim 10, wherein when no tone is detected in the FFT of the instantaneous frequency distribution, the classifying step further includes the steps of determining the kurtosis coefficient of the instantaneous frequency distribution, such that the type of modulation is classified as Frequency Shift Keying (FSK) when the kurtosis coefficient is below a predetermined coefficient threshold.

12. The method of claim 11, wherein when the kurtosis coefficient is above a predetermined threshold, the classifying step further includes obtaining the FFT of the squared value of the pre-processed signal and counting the number of peaks contained in said FFT, such that when the number of peaks is more than one, the type of modulation is classified as FSK, having a number of modulation levels equal to the number of peaks; and as analog FM otherwise.

13. The method of claim 12, wherein the step of obtaining the instantaneous frequency distribution includes the steps of:

(a) computing the instantaneous phase distribution of the pre-processed signal;

(b) estimating the bandwidth of the instantaneous phase distribution;

(c) low-pass filtering the instantaneous phase distribution to generate a filtered phase distribution; and

(d) estimating time derivative of the filtered phase distribution.

14. The method of claim 1, wherein when the type of envelope is identified as an irregular envelope, the step of classifying the type of modulation includes a step of obtaining from the carrier-corrected signal the variance of the absolute phase $\phi_a(t) = \angle(|I(t)| + j|Q(t)|)$ for signal samples above the mean signal amplitude, such that the type of modulation is classified as being:

(a) one of Amplitude Modulation (AM), Double Sideband Suppressed Carrier (DSB-SC), and Binary Phase Shift Keying (BPSK), when the absolute phase variance is below a predefined phase threshold; and

(b) one of Quarternary Phase Shift Keying (QPSK), π/4-QPSK, *M*-ary PSK, and OTHER, when the absolute phase variance is above said phase threshold.

15. The method of claim 14, wherein when the absolute phase variance is below the phase threshold, the classifying step further includes a step of obtaining from the carrier-corrected signal the direct phase variance for signal samples above the mean signal

amplitude, such that the type of modulation is classified as being one of DSB-SC and BPSK when the direct phase variance is above the phase threshold, and as AM otherwise.

16. The method of claim 15, wherein when the direct phase variance is above the phase threshold, the classifying step further includes a step of determining the amplitude variance of the carrier-corrected signal, such that the type of modulation is classified as DSB-SC when the amplitude variance is above a predefined amplitude threshold, and as BPSK otherwise.

17. The method of claim 14, wherein when the absolute phase variance is above the phase threshold, the classifying step further includes a step of obtaining from the pre-processed signal the amplitude variance, such that the type of modulation is classified as OTHER when the amplitude variance is above a predefined amplitude threshold, and as PSK otherwise.

18. The method of claim 17, wherein when the amplitude variance is below the amplitude threshold, the classifying step further includes a step of applying a fourth power non-linearity to the pre-processed signal followed by computing Fast Fourier Transform to generate an FFT output; such that the type of modulation is classified as QPSK if the FFT output bears only one discrete component, as $\pi/4$-QPSK when the FFT output bears two discrete components, and as M-ary PSK with M larger than 4 otherwise.

19. A method for recognizing the type of modulation of a complex baseband signal extracted from a modulated signal having a carrier frequency, said method comprising the steps of:

(a) detecting presence of the baseband signal by estimating the power spectral density thereof with the aid of externally measured background noise power, and comparing said power spectral density against a power threshold derived from the background noise and a predefined probability of detection;

(b) estimating baseband frequency bandwidth by comparing the power spectral density against a bandwidth threshold derived from the background noise and a predefined bandwidth estimation error and a predefined probability of detection;

(c) estimating main centroid frequency of the baseband signal, by computing a component centroid frequency of at least one frequency component in the power spectral density bearing a power above the bandwidth threshold;

(d) performing gross carrier error correction by frequency translating the baseband signal by the main centroid frequency, followed by low-pass filtering with a filter bandwidth derived from the baseband frequency bandwidth, thereby generating a pre-processed signal from the baseband signal;

(e) examining amplitude variations in the pre-processed signal to identify the type of envelope thereof as being one of a constant envelope and one of an irregular envelope;

(f) estimating the carrier frequency error in the pre-processed signal by performing the steps of:

(i) obtaining the normalized squared amplitude of the carrier-corrected signal and applying thereto a Fast Fourier Transform with zero-padding to generate an FFT output;

(ii) squaring the absolute values of the FFT output to generate a frequency spectrum;

(iii) searching the frequency spectrum to find a maximum-power frequency sample; and

(iv) performing a fine search for the carrier frequency error, by applying one step of a secant optimization process to the maximum-power frequency sample and the pre-processed signal;

when the type of envelope is identified as a constant envelope; and

by performing the steps of:

(v) obtaining the normalized squared amplitude of the carrier-corrected signal and applying thereto a Fast Fourier Transform with zero-padding to generate an FFT output;

(vi) obtaining the square of the absolute values of the FFT output to generate a frequency spectrum;

(vii) searching the frequency spectrum to find a maximum-power frequency sample;

(viii) performing a fine search for the carrier frequency error, by applying one step of a secant optimization process to the maximum-power frequency sample and the output of the normalized squared amplitude signal,

when the type of envelope is identified as an irregular envelope;

(g) correcting the pre-processed signal for the carrier frequency errors to generate a carrier-corrected signal; and

(h) classifying the type of modulation in the carrier-corrected signal, based on the type of envelope,

by performing the steps of:

(i) obtaining the direct phase variance for samples of the carrier-corrected signal above the mean amplitude of the carrier-corrected signal;

(ii) comparing the direct phase variance to a predefined phase threshold; and

(iii) classifying the type of modulation as Continuous Wave when the direct phase variance is below the phase threshold, and as Frequency Modulation when the direct phase variance is above the phase threshold,

when the type of envelope is identified as a constant envelope, and by performing the step of classifying the type of modulation includes a step of obtaining from the carrier-corrected signal the variance of the absolute phase $\phi_a(t) = \angle\left(|I(t)| + j|Q(t)|\right)$ for signal

samples above the mean signal amplitude, to classify the type of modulation when the absolute phase variance is below a predefined phase threshold as being one of Amplitude Modulation, Double Sideband Suppressed Carrier, and Binary Phase Shift Keying, and, when the absolute phase variance is above a pre-defined phase threshold, as being one of Quarternary Phase Shift Keying (QPSK), π/4-QPSK, *M*-ary PSK, and OTHER, when the type of envelope is identified as an irregular envelope.

20. A system for recognizing the type of modulation of a modulated signal having a carrier frequency comprising:

(a) a receiver section for extracting from the modulated signal a complex baseband signal;

(b) a pre-classification stage for generating a pre-processed signal from the baseband signal;

(c) means for examining amplitude variations in the pre-processed signal to identify the type of envelope thereof as being one of a constant envelope and an irregular envelope;

(d) means for estimating the carrier frequency error in the pre-processed signal;

(e) means for correcting the pre-processed signal for the carrier frequency errors to generate a carrier-corrected signal; and

(f) means for classifying the type of modulation in the carrier-corrected signal, based on the type of envelope identified in the examining step.

21. The system of claim 20, wherein the generating means include means for detecting presence of the baseband signal by estimating the power spectral density thereof with the aid of externally measured background noise power, and comparing said power spectral density against a power threshold derived from the background noise and a predefined probability of detection.

22. The system of claim 21, wherein the generating means further includes means for gross error correction of the carrier frequency.

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23. The system of claim 22, wherein when the type of envelope is identified as a constant envelope, the type of modulation is classified according to the phase and frequency contents of the pre-processed and carrier-corrected signals.

24. The system of claim 22, wherein when the type of envelope is identified as an irregular envelope, the type of modulation is classified according to the phase and amplitude contents of the carrier-corrected signal.